Introduction - Significance of the Inv ntion

The year 1993 witnessed a paradigm shift in water treatment, with the promulgation of the National Sewage Sludge Use and Disposal Regulation (40 C.F.R. § 503).

Prior to 1993, water treatment plants employed mesophilic bacteria. These bacteria were favored, because they were active at ambient temperatures of the water treatment plant. Thermophilic bacteria would require heating, which of course adds equipment and cost to the water treatment process. Thus, while it might have been known that thermophilic bacteria could, be used in water treatment plants, it was not ever done because of the increased costs. Therefore, there was no real data on what process advantages/disadvantages such thermophilic bacteria would cause (other than increased cost/time).

In fact, the prior art (Gould) actually suggested that thermophilic bacteria would be easy to dewater.

However, after 1993, under certain circumstances under § 503, water treatment plants would employ, thermophilic bacteria.

Thus, before 1993, water treatment plants employed mesophilic bacteria. After 1993, the conventional process was to employ mesophilic bacteria, and while by far the vast majority of water treatment plants still employed mesophilic bacteria, a very small number of non-conventional plants were employing thermophilic bacteria.

The major distinction between mesophilic and thermophilic bacteria is that mesophilic bacteria naturally secrete a polysaccharide that is tackifying (i.e., clump them together), whereas thermophiles lack such a polysaccharide and appear "buckshot" (i.e., scattered); ref. Haase col 2 lines 44 - 55. This tackifying polysaccharide encourages and helps promote a natural coagulation and a natural formation of microfloc of the mesophiles.

Thus, one difference between dewatering of mesophiles and thermophiles is that mesophiles have the presence of this polysaccharide to encourage and helps promote a natural coagulation and a natural formation of microfloc of the mesophiles, whereas thermophiles lack such a polysaccharide. Thus, the mesophiles generally have a "head start" in coagulation and formation of microfloc.

Nielsen Discussion

Applicant would like to point out to the Examiner inventive history regarding the use of a polyquaternary ammonium compound with a polyacrylamide (cationic or anionic) in the dewatering of thermophiles or sludge from a thermophilic digestion process.

As can be readily ascertained from the parent application of Applicant, specifically USP 5,846,435 which issued from application 08/721,557. Said application was filed 9/26/96 portions of which are further documented in the attached Declaration of Richard Haase and of Audrey Haase, wherein Richard Haase performed an on-site plant demonstration of the subject technology at College Station, Texas on or about 9/10/96. College Station operates an ATAD system. Further, as can be readily ascertained by examples in the Application and is documented in the Declarations, at the time of Richard Haase's performance testing in College Station, the ATAD waste bio-solids were being dewatered with a single dry polyacrylamide, Nalco 9909, having poor dewatering performance.

Due to equipment needs of the client, The City of College Station, preferred to operate with a dry polymer system. Therefore, the Applicant contacted Allied Colloids to obtain a dry version of DADMAC. At that time, Allied Colloids was the only manufacturer. After having significant business issues with Allied Colloids to obtain a dry DADMAC polymer, Richard Haase noted Allied Colloids and Kruger to be performing plant testing in College Station on or near December of 1996 utilizing the chemistry presented to Allied Colloids by Richard Haase in October of 1996.

Due to this chain of events, the Applicant presents that the Nielsen patent should not be valid and may not have been filed according to the rules of the USPTO.

Claims Reconstruction

Applicant wishes to point out to the Examiner that the pending claims in this application have been reconstructed in order to incorporate the many appropriate remarks made by the Examiner. Included in this Office Action Response is a "clean" set of claims and a "marked" set of claims, wherein said marks refer only to the original published set of claims in U.S. Pat. No. 5,906,750.

Original Patent

The original patent, or a statement as to loss or inaccessibility of the original patent, must be received before this reissue application can be allowed. See 37 CFR 1.178.

Applicant's Response

Applicant understands this requirement, and confirms his 5/24/01 and 8/22/02 offer to surrender the original patent. Upon this application being in preparation for allowance, the original patent will be returned to the US Patent Office according to 37 CFR 1.178.

Objections Relating to the Manner by Which Claims Have Been Amended

Claims 1, 4, 7, 8, 10, 11, 14, 15, 25 are objected to under 37 CFR 1.173(d). It is only those changes to the text of claims **'relative to the patent being reissued"** which must be shown in the markings. Insofar as the misspelling "polyacrylamidee" [sic] did not appear in the patent's claims, but rather was introduced in this reissue application itself (paper no. 1 filed 5/25/01), the attempted correction of the various instances of that typographical error in the amendment filed August 4, 2002, should NOT be market at all. That is, it should not be market – [polyacrylamidee] <u>polyacrylamide</u> – as was done in the August 14, 2002 paper. Instead, a complete copy of each such claim bearing the "polyacrylamidee" [sic] typo should be presented in response to objection even if no changes vis-à-vis the issued claim are to be made. For example, to overcome this objection to claim 1, claim 1 should be presented as:

> 1. A method for dewatering biological sludge that has been digested by a thermophillic digestion process comprising:
> a. adding <u>a</u> polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride and blends thereof, as primary component, to the biological sludge; and
> b. adding polyacrylamide to the biological sludge; such that any combination of the primary component and of the polyacrylamides enhance dewatering of the sludge.

The "a" at line 3 is underlined because that word does not appear in the issued patent. Even though "polyacrylamide" appears in the claims presented in the paper filed May 25, 2001, it should not appear in any form – bracketed or otherwise – because that misspelling does not appear in the issued patent claim. In reissue practice, claim markings are made only to show

textual changes relative to the claims as they appeared in the issued patent. If you have any further questions about this, please telephone the examiner for clarification. The examiner leaves it to the applicant to ensure that claims 1, 4, 7, 8, 10, 11, 14, 15, 25 are presented with proper markings in the next response.

Furthermore, claims 16 – 18, 21, 24, 27, 35 – 36 (as presented on August 14, 2002) are objected to under 37 CFR 1.173(d)(2) for want of these **new** claims (relative to the issued patent) to be shown entirely underlined.

Similarly, claims 37 – 38 (as presented on May 25, 2001) are objected under 37 CFR 1.173(d)(2) for want of the **entirety** of claim 37 to be underlined and for **none** of claim 38 to be underlined. See the unnumbered page immediately following page 28 of the preliminary amendment filed May 25, 2001: None of the portions of the new claims 37 and 38 appearing on this pager were underlined.

Claim 10 is separately objected to for want of the claim to appear marked as follows: "... is then added for [final] fmal floc formation." To the extent that incursion of "fmal" was inadvertent, claim 10 should be re-presented – if claim 10 as issued is the claim for which applicant seeks further examination – as claim 10 as issued without any markings (underlinings or bracketing).

Claim 11 is separately objected to for want of the claim to appear marked as follows: "... with the anionic polyacrylamidee having a higher...." To the extent that incursion of the extra "e" in "polyarcrylamidee" was inadvertent, claim 11 should be re-presented – if claim 11 as issued is the claim for which applicant seeks further examination – as claim 11 as issued without any markings (underlinings or bracketing).

Applicant's Response

Applicant understands the requirement of 37 CFR 1.173(d) and 37 CFR 1.173(d)(2). Applicant appreciates the examiner's remarks. Applicant has attached a marked up version of the claims and a clean set of claims that include the examiner's remarks. **Please not that claims 16 – 21 are new in this response.**

35 USC §103 – Nielsen / Sorensen

Claims 1, 2, 4, 5, 6, 7, 8, 9, 14, 15, 16, 21, 25, 26, 23, 33, 17, 22, 28, 18 are rejected under 35 USC Sec. 103(a) as being obvious over Nielsen, Sorensen, and Pohoreski, as interpreted in the light of Haldeman and either Schwab or Wilker.

Claim 1 is directed to a method for dewatering biological sludge that has been digested by a thermophilic digestion process. Paraphrasing claim 1, the method comprises:

Digesting a biological sludge by a thermophilic digestion process;

Adding polymeric quaternary ammonium "compounds" [sic], aluminum sulfate, ferric chloride "and blends thereof," as primary component, to the digested biological sludge; and

Adding polyacrylamide to the digested biological sludge, *such that* any combinations of the primary component and of the "polyacrylamides" [sic] enhance dewatering of the sludge.

USP 5954964 to Nielsen describes digesting a biological sludge by a thermophilic digestion process ("digester 30," col 1 liens 57-65; col 2 line 55). Nielsen also describes adding a lower molecular weight polymer as a primary component, i.e., as a coagulant. Specifically, Nielsen states:

a. "Various types of low molecular weight polymers...can be used in the process of the present invention."
b. "[T]he low...molecular weight polymers are usually polyacrylamide polymers," and
c. "[S]uitable low molecular weight polymers are Percol 402, Percol 406, Alkafix 357."

As shown by either USP 5069831 to Schwab (col 4 line 11-12) or USP 5126013 to Wiker (col 5 lines 4-6), Percol 406 is polyDADMAC, a polymeric quaternary ammonium compound (i.e., coagulant) to the digested sludge. Nielsen also describes addition of a higher molecular weight polymeric flocculent, e.g., Percol 757, to the digested sludge to improve sludge dewatering (col 6 line 41 – line 67). As shown by USP 4396513 to Halderman (col 5 lines 7, 45 – 47), Percol 757 is a polyacrylamide type polymer. Nielsen then dewaters the polymer-treated sludge. Per claim 17, see Nielsen col 6 line 51 ("simultaneously"). Per claims 4 and 18, Nielsen describes addition of a cationic polyacrylamide (col 7 line 32).

Nielsen does not appear to anticipate claim 1 because Nielsen does not describe addition of "aluminum sulfate, ferric chloride and blends thereof, as primary component" along with the Percol 406 (polyDADMAC) polymeric quaternary ammonium compound to the digested sludge.

Like Nielsen, WO 95/33697 to Sorensen is directed to the problem of dewatering sewage sludge (page 1 lines 4 – 5). Sorensen teaches that it was known to treat the sewage sludge suspension with an inorganic coagulant, such as aluminum sulfate (page 12 line 16) or ferric chloride (page 12 line 16+), and a polymeric flocculent (page 1 lines 8 – 17). Alternatively, Sorensen teaches using a polymeric coagulant and a polymeric flocculant.

In view of Sorensen's teaching of the functional equivalence of using an inorganic coagulant and polymeric flocculant on the one hand, or a polymeric coagulant and a polymeric flocculant on the other hand, it would have been obvious to have substituted an inorganic coagulant, e.g., aluminum sulfate or ferric chloride, for Nielsen's Percol 406, thereby resulting in the use of an inorganic coagulant and a high molecular weight polymeric flocculant. Furthermore, since Nielsen or Sorensen show the suitability of any of the following coagulants (listed below at left)(next page) and a higher weight polymeric flocculant (shown below at right)(next page), it would have been obvious to have used any combination of the coagulant compounds together with the higher molecular weight flocculant. Simultaneous use of a combination of more than one type of coagulant (in addition to the polymeric flocculant) is clearly suggested by Sorensen's description of using both ferric chloride and polyDADMAC in Example 8 ("ferric chloride" – "polyDADMAC"). Moreover, USP 4882069 to Pohoreski expressly teaches that a combination of aluminum sulfate, "iron chloride," and polyelectrolytes can be used in "combination" to dewater sludge (col 1 line 38).

Coagulant	Flocculant
polyDADMAC (Percol 406)(Nielsen)	higher weight polymeric flocculant
Ferric chloride and polyDADMAC (Sorensen Example 8)	
Aluminum Chloride (Sorensen)	
Ferric chloride (Sorensen)	

Accordingly, it would have been obvious to have used a combination of ferric chloride, polyDADMAC, aluminum sulfate, and "blends thereof" as a coagulant "cocktail" in combination

with a higher weight polymeric flocculant for the purpose of dewatering a thermophilic-digested biological sludge, as suggested by Nielsen, Sorensen and Pohoreski.

Per claims 5 – 9, it would have been obvious to have used any proportion of the various coagulants in the "coagulant cocktail" insofar as the art suggests the functional equivalence and use in combination of the various coagulants, including ferric chloride, aluminum sulfate, polyDADMAC, and low molecular weight polyacrylamide.

Applicant's Response

While applicant does appreciate the Examiner's position, the applicant wishes to present to the Examiner why Nielson, Sorensen and Pohoreski do not render said claims obvious.

For the purpose of discussion, Applicant will use claim 1 as a guide. Claim 1 as well as all of the independent claims, requires:

A method for dewatering biological sludge, comprising:

a. adding a primary component to the thermophilic biological sludge; said primary component comprising at least one of aluminum sulfate and ferric chloride; wherein
   said primary component may also comprise a polyquaternary ammonium compound; and
b. adding a cationic or anionic polyacrylamide to the thermophilic biological sludge.

While Nielsen does present the dewatering of digested thermophilic bacteria, Nielsen does not teach the importance of either the quaternized moiety, or of the use of a salt in lieu said quaternized moiety, or of a salt in combination with said quaternized moiety. In actuality Nielsen teaches the use of low and high molecular weight polymers, specifically, col 2 lines 60 – 65,

> "In order to increase the dewatering efficiency, the present invention adds both a low molecular weight polymer and a high molecular weight polymer into treated biosolids..."

col 5 lines 10 – 15,

> "The addition of both a low molecular weight polymer and a high molecular weight polymer to the biosolids greatly increase flocculation efficiency during dewatering."

Many polymers exist which do not have a quaternized moiety, most notably secondary and tertiary amines, as well as anionic polymers of acrylic acid moiety and non-ionic polymers of acrylamide. Further, Nielsen teaches to use polyacrylamide polymers for both the high and the low molecular weight components, while **not teaching a required charge moiety or a specific charge,** specifically col 6 lines 55 – 60,

> "[V]arious types of low molecular weight polymers and high molecular weight polymers can be used in the process of the present invention. Both the low and the high molecular weight polymers are usually polyacrylamide polymers, but other types of polymers may be used."

Using this teaching there are many types of polyacrylamide polymer combinations, which could be used and which would not perform, most notably a non-ionic low molecular weight and a non-ionic high molecular weight polyacrylamide. Or, one could evaluate a non-ionic low molecular weight with an anionic polyacrylamide, which would not perform. Or, one could evaluate a low molecular weight anionic polymer, of any type, with a non-ionic polyacrylamide; this combination would not perform, either.

By not understanding and teaching the difference between mesophilic and thermophilic bacteria, Nielsen has presented an invention wherein most of the embodiments will not perform. This conclusion is referenced in the attached Declaration by the inventor, Mr. Richard A. Haase.

Further, Nielsen did not teach the use of any metal salt. By teaching the use of low molecular weight and high molecular weight polymers without teaching as to the need of a quaternary charge or of a high cationic charge moiety to counteract the repulsive force of the thermophiles, Nielsen has no teaching as to the importance or the significance of a quaternized cationic coagulant; therefore, there is no teaching or suggestion which would lend to the use of a metal salt, such as ferric chloride or aluminum sulfate.

Sorensen, as with Nielsen, does not present the importance of a quaternized or a highly cationic charged coagulant, polyquaternary amine and/or a metal salt to be used with a cationic or anionic polyacrylamide. Most importantly, Sorensen does not <u>at all</u>

discuss thermophiles or thermophilic bacteria or the dewatering of thermophiles or of thermophilic bacteria. Sorensen's patent publication is primarily focused on the optimization of separated cake solids with separated liquor clarity; Sorensen presents process control in the addition of a coagulant, wherein the coagulant is used in combination with a predetermined dosage of flocculant, again with no reference to thermophilic bacteria. Specifically, page 1 lines 18 – 33,

> "It is well known that it is necessary to select the optimum dose of a flocculant in order to obtain optimum dewatering, but what constitutes optimum dewatering in any particular process depends upon the objective of that process. For example, in some processes the primary objective is to provide a cake having the highest possible solids content whilst in other processes the objective may be to provide separated liquor having the highest clarity and lowest turbidity. There is usually a conflict between optimizing cake solids and optimizing clarity, probably because the very fine hydrophilic suspended solids that cause inferior clarity may tend to hold water in the cake if they are trapped in the cake rather than left as turbidity in the separated liquor. Accordingly, the operator has to select an optimum which may be based on optimizing cake solids or clarity or a compromise."

Again, page 4, lines 3 – 14,

> "The invention provides a process for dewatering a feed suspension comprises flocculating the feed suspension by adding a predetermined dose of polymeric flocculant having intrinsic viscosity of at least 4dl/g and dewatering the flocculated suspension to produce a cake and a separated liquor. In the invention a parameter of the feed suspension, the flocculated suspension or the separated liquor is monitored and an ionic coagulant is added to the feed suspension, before the flocculant, in an amount sufficient to maintain the parameter substantially at a predetermined value during prolonged operation of the process."

Again, page 5, lines 21 – 36,

> "The invention facilitates the maintenance of the efficiency of the dewatering process at conditions that are close to those which have been preselected as being the optimum for the process. Thus, once the operator has selected conditions which the operator judges to be as good as can reasonably be obtained with the equipment and flocculant available to the operator (i.e., the preselected optimum) it is then possible to maintain the performance of the process close to this preselected optimum by varying the amount of coagulant so as to maintain the performance of the process close to the preselected optimum by varying the amount of coagulant so as to maintain the monitored valued substantially constant. Thus it is possible to maintain the solids content of the cake at or close to the value which is the preselected optimum for that process.

> Alternatively, it is possible to maintain the suspended solids content of the separated liquor at a value close to the preselected optimum for that process."

In a further demonstration that Sorensen teaches a method of process control and does not teach a method for the dewatering of thermophiles or of sludge digested by thermophilic digestion, page 12 lines 3 – 9,

> "Usually the coagulant and the flocculant are both ionic and are preferably coionic. Thus when the suspension has characteristic such that it can suitably be flocculated using an anionic polymeric flocculant, the coagulant is usually anionic. Suspensions that can be flocculated with an anionic flocculant include various mineral suspensions."

Pohoreski, as with Nielsen and Sorensen, does not teach or suggest the importance of a quaternized or a highly cationic charged coagulant, polyquaternary amine and/or a metal salt to be used with a cationic or anionic polyacrylamide. Most importantly, Pohoreski does not <u>at all</u> discuss thermophiles or thermophilic bacteria or the dewatering of thermophiles or of thermophilic bacteria.

In actuality, Pohoreski teaches a process of water clarification and not a process of bio-solids or sludge dewatering. As such, Pohoreski teaches a method of creating sludge by water or sewage clarification, as compared to a method of sludge dewatering or most importantly a method of dewatering thermophiles or sludge that has been thermophilic digested. In the abstract,

> "The method includes adding, to the sewage or other impure water in a mixing zone, all three individually but no more than two premixed together of the following: (a) an inorganic coagulant, (b) an anionic polymer, and (c) a cationic polymer, with intimate mixing of the added chemicals with the sewage or other impure water, with the proviso that (d) the inorganic coagulant, either alone or with the anionic polymer or the cationic polymer, cannot be added last; and (e) the anionic polymer and the cationic polymer cannot be intimately mixed and added together."

Further, the use of a metal salt, ferric chloride or aluminum sulfate, alone or with a quaternized coagulant is against industry knowledge at the time of Nielsen, Sorensen and Pohoreski. Industry knowledge, at that time, was <u>not</u> to use a quaternized amine or metal salt, such as ferric chloride or aluminum sulfate, in combination with a cationic polyacrylamide. Attached to this response is a paper prepared by Chitikela and Dentel

published in 1996, which teaches against the use of ferric chloride or a quaternized moiety (HDTMA) as a conditioner for a cationic polyacrylamide. Specifically, on page 11-27:

> "Figure provides the results of conditioning and dewatering results for both the EBMUD sludge, when conditioned with Percol 757, ferric chloride, or HDTMA individually. These results once again confirm that cationic polymers are very effective in sludge conditioning when compared to the inorganic chemical conditioning with ferric chloride. Use of a cationic surfactant in sludge conditioning is unconventional, but its optimum does on a mass basis when comparable to that of ferric chloride. However, this finding is of little practical use since HDTMA is significantly more expensive than ferric chloride or flocculant polymers per unit mass."

Further, the combination of Nielsen, Sorensen and Pohoreski would not have been obvious to one of ordinary skill in the art because it was generally known by those of ordinary skill in the art that thermophiles or thermophilic biological sludge was not easily dewatered. One of ordinary skill in the art would be a person with a degree in environmental science, or many years of on the job training plus state certification. At the time of the conception and reduction to practice of the claimed invention, one of ordinary skill in the art would have knowledge of the Environmental Protection Agency (EPA) and its rules, regulations and recommendations. In particular, one of ordinary skill in the art would have knowledge of an EPA publication: TBS Prakasam, S Soszynski, DR Zenz, C Lua-Hing, L Blyth, and G Sernel, *Effect of Recycling Thermophilic Sludge on the Activated Sludge Process,* EPA Project Summary 5, Sept. 1990, which stated under the heading:

> "Dewaterability
>
> Capillary suction time (CST) measurements at various polymer dosages indicated that mesophilic sludge required a lower polymer dosage than did the thermophilic sludge (10 vs. 22.5 kg/dry tonne) to achieve the minimum CST that was possible. The thermophilic sludge, however, exhibited a higher floc strength than did the mesophilic sludge.
>
> Pilot scale centrifuge studies confirmed that the thermophilic sludge required a higher polymer dosage than did the mesophilic sludge. At optimum polymer dosages, those studies also indicated that the mesophilic sludge approached 100% solids capture whereas the thermophilic solids approached a maximum of 96% solids capture. The lower solids capture with thermophilic sludge probably resulted from the higher concentration of fine particles in it than in the mesophilic sludge."

And, recommends that:

> "Based on the lack of effect on sludge mass end the increase in digestion capacity required, the Torpsy process is not recommended for Chicago's conventional rate activated sludge plants. Nor is thermophilic digestion as the terminal sludge digestion process recommended if the sludge is to be used at a site with nearby neighbors."

Applicant, in his Background of the Invention, explained why dewatering thermophilic biological sludge is difficult (i.e. Column 2 lines 33-36): "This repelling nature of thermophilic bacteria makes the dewatering of sludge from the thermophilic digestion process expensive and difficult."

Even as late as 2000, a paper given at WEFTEC by scientist at Virginia Polytechnic Institute, attached, concluded that: "Thermophilic anaerobic digestion results in poor sludge dewatering characteristics."

One of ordinary skill in the art would be either employed by a municipality or industry in the environmental services center, or a supplier to one of those organizations. The disposal of sewage is a tax burden to municipalities and a cost burden to industry. Both would prefer to dump the sewage into the closest stream and let the down stream inhabitants worry about the disposal problem. It is only because of state and federal regulations that either is taking corrective action. Therefore, financial considerations would be important to a person of ordinary skill in the art. The above quoted EPA report stated that: "At optimum polymer dosages, those studies also indicated that the mesophilic sludge approached 100% solids capture whereas the thermophilic solids approached a maximum of 96% solids capture." The 96% solids capture would require the additional and substantial expense of recirculating the additional solids, sludge, through the treatment facility. Due to this cost factor, a person of ordinary skill, upon reading the Chitikela and Dentel reference and/or having knowledge of the EPA report, would be led in a direction divergent from the path that was taken by Applicant.

Additionally, the combination of references would not be obvious to one of ordinary skill in the art to practice and the claimed inventions could not be achieved without undue experimentation. The experimentation expectation is accurately confirmed by Chitikela and Dentel on page 11-25 which states:

"The optimal chemical conditioning and dewatering of a municipal sludge is a challenging task. This is due to the complex and changeable physical/chemical makeup of these materials. The means by which chemical conditions interact with the colloidal phase in biological suspension is to facilitate the release of water is poorly understood, with the optimal amounts and types of conditioners required depending on a variety of factors. These include both aqueous and surface chemistries of the sludge, and the physical properties of the suspended solids. Also important is the chemistry of any chemical conditioner used, and how it interacts with the biosolids. The success of any conditioning process will also depend on the specific dewatering process employed. Thus, the sludge conditioning process is a multivariate problem with no simple strategy available for its optimization."

Thus, **<u>the conditioning process is a multivariate problem with no simple strategy available for its optimization</u>**. At present, the required dosages for chemical conditioning must be determined empirically. With this being the case, the use of multiple chemical additives becomes less feasible because of the difficulty in identifying a proper dose combination." (Emphasis added.)

Thus, the quantity of experimentation necessary to achieve Applicant's claimed inventions is substantial. At the time of the reduction to practice by Applicant, there would have been no direction or guidance provided by the prior art. There were no successful examples; just the opposite as demonstrated in the EPA document. The claims relate to treatment of sewage and thus, to experiment would require the availability of a sewage treatment plant and the financial resources necessary to obtain the different chemical compounds and to carry out the experimentation. Prior to Applicant's disclosures, the cause of the difficulty of treating thermophilic sludge was not known and thus, the teachings of the prior art were unpredictable. Applicant's claims are species claims and would require additional experimentation to be reduced to practice as compared to generic claims. Further, Applicant's claims go against established prior art. The skill of the practitioner was previously defined as an environmental engineer or scientist and thus would only have a limited knowledge of organic chemistry and microbiology. Consequently, one of ordinary skill in the art would not have enough in depth knowledge to understand the working of Applicant's claimed invention from the referenced cited.

In conclusion, the cited combination of references does not teach or suggest Applicant's treatment of thermophilic biological sludge "A method for dewatering thermophilic bacteria, comprising:

a. adding a primary component to the thermophilic biological sludge; said primary component comprising at least one of aluminum sulfate and ferric chloride; wherein
   said primary component may also comprise a polyquaternary ammonium compound; and
b. adding a cationic or anionic polyacrylamide to the thermophilic biological sludge.

In view of the above stated fact, reconstructed claims 1 – 21 should be allowable over the combination of Nielsen, Sorensen, and Pohoreski.

Claims 16, 18

Claims 16, 37, 38, 23 and 18, 29 are rejected under 35 USC §103(a) as obvious over Sorensen and Gould.

Claims 16 and 18 are directed to a method for dewatering biological sludge that has been digested by a thermophilic digestion process. Paraphrasing claim 16, the method comprises:

Digesting a biological sludge by a thermophilic digestion process;

Adding a polymeric quaternary ammonium compound and at least one of aluminum sulfate and ferric chloride to the digested biological sludge; and

Adding polyacrylamide to the digested biological sludge, *such that* the combination of the polymeric quaternary ammonium compound, aluminum sulfate and/or ferric chloride, and the polyacrylamide enhances dewatering of the sludge. Claim 18 does not require addition of a polymeric quaternary ammonium compound or aluminum sulfate, but does require addition of ferric chloride.

Sorensen (at Example 8, page 21 – 22) describes:

Digesting a biological sludge by a digestion process ("biological solids" page 21 line 29);

Adding a polymeric quaternary ammonium compound ("poly DADMAC" at page 22 line 1) to the sludge;

Adding at least one of aluminum sulfate and ferric chloride ("ferric chloride" page 21 line 30) to the digested biological sludge; and

Adding a polyacrylamide ("a high molecular weight polymer" page 21 line 31, "a flocculant copolymer comprising acrylamide" page 22 lines 8 – 10) to the digested biological sludge, *such that* the combination of the polymeric quaternary ammonium compound, aluminum sulfate and/or ferric chloride, and the polyacrylamide enhances dewatering of the sludge.

Sorensen does not state whether the digestion process was a "thermophilic digestion process." It would have been obvious to have digested the biological sludge by a thermophilic digestion process prior to addition of the dewatering conditioners. (coagulant and flocculant) for the various reasons given by USP 4246099 to Gould, for example, explaining why thermophilic digestion is advantageous over mesophilic digestion. Among these reasons are more rapid sludge stabilization (col 5 line 23).

With respect to claim 29, the relative proportion of various components in a mixture or composition is generally known to be a result-effective variable, so optimization of the same would have been obvious in this case.

Applicant's Response

While applicant does appreciate the Examiner's position, the applicant wishes to present to the Examiner why Sorensen and Gould do not render said claims obvious.

The combination of Sorensen and Gould would not have been obvious to one of ordinary skill in the art because it was generally known by those of ordinary skill in the art that thermophiles or thermophilic biological sludge was not easily dewatered. One of ordinary skill in the art would be a person with a degree in environmental science, or many years of on the job training plus state certification. At the time of the conception and reduction to practice of the claimed invention, one of ordinary skill in the art would have knowledge of the Environmental Protection Agency (EPA) and its rules, regulations and recommendations. In particular, one of ordinary skill in the art would have knowledge of an EPA publication:

TBS Prakasam, S Soszynski, DR Zenz, C Lua-Hing, L Blyth, and G Sernel, *Effect of Recycling Thermophilic Sludge on the Activated Sludge Process,* EPA Project Summary 5, Sept. 1990. Which stated under the heading:

"Dewaterability

Capillary suction time (CST) measurements at various polymer dosages indicated that mesophilic sludge required a lower polymer dosage than did the thermophilic sludge (10 vs. 22.5 kg/dry tonne) to achieve the minimum CST that was possible. The thermophilic sludge, however, exhibited a higher floc strength than did the mesophilic sludge.

Pilot scale centrifuge studies confirmed that the thermophilic sludge required a higher polymer dosage than did the mesophilic sludge. At optimum polymer dosages, those studies also indicated that the mesophilic sludge approached 100% solids capture whereas the thermophilic solids approached a maximum of 96% solids capture. The lower solids capture with thermophilic sludge probably resulted from the higher concentration of fine particles in it than in the mesophilic sludge." and recommended that:

"Based on the lack of effect on sludge mass end the increase in digestion capacity required, the Torpsy process is not recommended for Chicago's conventional rate activated sludge plants. Nor is thermophilic digestion as the terminal sludge digestion process recommended if the sludge is to be used at a site with nearby neighbors."

Thus, when the reference to Gould states: "The major reasons for commercial acceptance of anaerobic sludge digestion are that this method is capable of stabilizing large volumes of dilute organic slurries, results in low biological solids (biomass) production, produces a relatively <u>easily</u> <u>dewaterable</u> <u>sludge</u> and is a producer of methane gas." (Emphasis added.) One of ordinary skill in the art would know that Gould et al. was not referring to thermophiles or thermophilic biological sludge. Therefore, the difference between Gould et al. and Applicant's claims is that all of Applicant's claims apply to thermophiles or thermophilic biological sludge, and the skilled practitioner would know that Gould et al, reference was not referring to thermophiles or thermophilic biological sludge when it stated: " ....this method is capable of stabilizing large volumes of dilute organic slurries, results in low biological solids (biomass) production, produces a relatively <u>easily</u> <u>dewaterable</u> <u>sludge</u> and is a producer of methane gas."

Applicant, in his Background of the Invention, explained why dewatering thermophilic biological sludge is difficult (i.e. Column 2 lines 33-36): "This repelling nature of thermophilic bacteria makes the dewatering of sludge from the thermophilic digestion process expensive and difficult."

Even as late as 2000, a paper given at WEFTEC by scientist at Virginia Polytechnic Institute concluded that: "Thermophilic anaerobic digestion results in poor sludge dewatering characteristics."

Conclusion, the ordinary skilled practitioner would know that thermophilic biological sludge is not easily dewatered and consequently Gould et al. does not teach or suggest Applicant's claimed inventions.

The use of a metal salt, ferric chloride or aluminum sulfate, alone or with a quaternized coagulant is against industry knowledge at the time of Sorensen and Gould. Industry knowledge, at that time, was not to use a quaternized amine or metal salt, such as ferric chloride or aluminum sulfate, in combination with a cationic polyacrylamide. Attached to this response is a paper prepared by Chitikela and Dentel published in 1996, which teaches against the use of ferric chloride or a quaternized moiety (HDTMA) as a conditioner for a cationic polyacrylamide. Specifically, on page 6:

> "Figures 1 and 2 show the results of conditioning and dewatering results for both the EBMUD and Philadelphia sludges, when conditioned with Percol 757, ferric chloride, or HDTMA individually. These results once again confirm that cationic polymers are very effective in sludge conditioning when compared to the inorganic chemical conditioning with ferric chloride. Use of a cationic surfactant in sludge conditioning is unconventional, but its optimum does on a mass basis when comparable to that of ferric chloride. However, this finding is of little practical use since HDTMA is significantly more expensive than ferric chloride or flocculant polymers per unit mass."

One of ordinary skill in the art would be either employed by a municipality or industry in the environmental services center, or a supplier to one of those organizations. The disposal of sewage is a tax burden to municipalities and a cost burden to industry. Both would prefer to dump the sewage into the closest stream and let the down stream inhabitants worry about the disposal problem. It is only because of state and federal regulations that either is taking corrective action. Therefore, financial considerations would be important to a person of ordinary skill in the art. The above quoted EPA report stated that: "At optimum polymer dosages, those studies also indicated that the mesophilic sludge approached 100% solids capture whereas the thermophilic solids approached a maximum of 96% solids capture." The 96% solids capture would require the additional and substantial expense of recirculating the

additional solids, sludge, through the treatment facility. Due to this cost factor, a person of ordinary skill, upon reading the Chitikela and Dentel reference and having knowledge of the EPA report, would be led in a direction divergent from the path that was taken by Applicant.

Additionally, the combination of references would not be obvious to one of ordinary skill in the art to practice and the claimed inventions could not be achieved without undue experimentation. The experimentation expectation is accurately confirmed by Chitikela and Dentel on page 11-25 which states:

> "The optimal chemical conditioning and dewatering of a municipal sludge is a challenging task. This is due to the complex and changeable physical/chemical makeup of these materials. The means by which chemical conditions interact with the colloidal phase in biological suspension is to facilitate the release of water is poorly understood, with the optimal amounts and types of conditioners required depending on a variety of factors. These include both aqueous and surface chemistries of the sludge, and the physical properties of the suspended solids. Also important is the chemistry of any chemical conditioner used, and how it interacts with the biosolids. The success of any conditioning process will also depend on the specific dewatering process employed. Thus, the sludge conditioning process is a multivariate problem with no simple strategy available for its optimization."

Thus, **<u>the conditioning process is a multivariate problem with no simple strategy available for its optimization</u>**. At present, the required dosages for chemical conditioning must be determined empirically. With this being the case, the use of multiple chemical additives becomes less feasible because of the difficulty in identifying a proper dose combination." (Emphasis added.)

Thus, the quantity of experimentation necessary to achieve Applicant's claimed inventions is substantial. At the time of the reduction to practice by Applicant, there would have been no direction or guidance provided by the prior art. There were no successful examples; just the opposite as demonstrated in the EPA document. The claims relate to treatment of sewage and thus, to experiment would require the availability of a sewage treatment plant and the financial resources necessary to obtain the different chemical compounds and to carry out the experimentation. Prior to Applicant's disclosures, the cause of the difficulty of treating thermophilic sludge was not known and thus, the teachings of the prior art were unpredictable; compare the difference between Gould et al.

and the EPA reference. Applicant's claims are species claims and would require additional experimentation to be reduced to practice as compared to generic claims. The skill of the practitioner was previously defined as an environmental engineer or scientist and thus would only have a limited knowledge of organic chemistry and microbiology. Consequently, one of ordinary skill in the art would not have enough in depth knowledge to understand the working of Applicant's claimed invention.

In conclusion, the cited combination of references does not teach the treatment of thermophilic biological sludge and consequently neither teach nor suggest the method of "adding a primary component to the thermophilic biological sludge; said primary component comprising at least one of aluminum sulfate and ferric chloride; wherein said primary component may also comprise a polyquaternary ammonium compound; and adding a cationic or anionic polyacrylamide to the thermophilic biological sludge."

In view of the above stated facts, reconstructed claims 1 – 21 should be allowable over the combination of Sorensen and Gould.

Epi-DMA

Claims 3 and 24 are rejected under 35 USC §103(a) as obvious over Nielsen, Sorensen, and Pohoreski (interpreted in light of Haldeman and either Schwab or Wiker), as applied above to claims 1 and 17, respectively, further in view of applicant's admission or USP 5965027 to Allen.

The prior art of record in this application appears to appreciate the interchangeability or functional equivalence of epi-DMA for DADMAC with respect to the micro floc formation function. See, for example, applicant's admission that "[p]olymeric quaternary ammonium compounds ... have been used for water clarification" listing DADMAC and epi-DMA as exemplary polyquat materials. Accordingly, it would have been obvious to have substituted epi-DMA for poly DADMAC in Nielsen's process. See also, for example USP 5965027 to Allen.

Applicant's Response

While applicant does appreciate the Examiner's position, the applicant wishes to present to the Examiner why Nielsen, Sorensen and Pohoreski in view of Allen do not render said claims obvious.

Applicant would like to repeat and refer to the discussions above in relation to Nielsen, Sorensen and Pohoreski. Applicant would further like to present to the Examiner that Allen presents a process of removing silica from water. Specifically, in the abstract:

> "A process and system for removing silica from large volumes of wastewater is disclosed. In the process, a wastewater stream containing silica is treated with a chemical coagulant, such as a epichlorohydrin/dimethylamine polymer, to create spherical particles which agglomerate into clusters having a diameter greater than 5 microns. Treated wastewater is passed through a microfiltration membrane which physically separates the silica contaminant particle from the wastewater."

While Allen does not teach or suggest any method or process to dewater thermophiles or sludge that has been digested by a thermophilic process, Allen does not even teach or suggest a method of dewatering. Allen presents a method of wastewater or water clarification utilizing membranes.

In view of the above stated facts, reconstructed claims 3 and 20 should be allowable over the combination of Nielsen, Sorensen, and Pohoreski (interpreted in light of Haldeman and either Schwab or Wiker), as applied above to claims 1 and 17, respectively, further in view of applicant's admission or USP 5965027 to Allen.

"Primary Sludge"

Claims 13, 34, 35, and 36 are rejected under 35 USC § 103(a) as obvious over Nielsen, Sorensen, and Pohoreski (interpreted in light of Haldeman and either Schwab or Wiker), as applied above to claims 1, 16, 17, and 18, respectively, further in view of one or more of USP 4380496, USP 3613564, and USP 3397139.

As shown by at least one of USP 4380496, USP 3613564, and USP 3397139, it is conventional to mix secondary biological solids with primary sludge for achieving the desired solids concentration prior to dewatering. It would have been obvious, therefore, to have mixed the digested biological solids of the primary reference with primary sludge solids before conditioning and before dewatering to achieve the desired solids concentration, as suggested by one or more of USP 438496, USP 361564, and USP 3397139.

Applicant's Response

While applicant does appreciate the Examiner's position, the applicant wishes to present to the Examiner why Nielsen, Sorensen and Pohoreski interpreted in light of Haldeman and either Schwab or Wilker and further in view of USP 4380496, USP 3613564, and USP 3397139 do not render said claims obvious.

Applicant agrees with the Examiner that it is a common practice to mix biological solids with primary solids. However, Applicant would like to present to the Examiner that the mixing of biological solids with primary solids prior to dewatering is not performed to determine the outcome of dewatering. On the contrary, biological solids are mixed with primary solids because both solids streams require dewatering and it is much more efficient to utilize the same dewatering equipment to effect dewatering for both streams.

Applicant would like to present to the Examiner that the novelty presented is in the mixing of <u>thermophilic biological solids</u> with primary solids. Applicant would like to present to the Examiner that USP 4380496, USP 3613564 and USP 3397139 do not teach or suggest the dewatering of thermophilic sludge, thermophilic bio-solids, or of dewatering sludge from a thermophilic digestion process.

USP 4380496 does not teach or suggest a chemical method of conditioning sludge. Further, USP 4380496 is silent on thermophiles or the dewatering of thermophiles or of sludge digested by a thermophilic digestion process. USP 4380496 only presents a mechanical means of dewatering sewage sludges, specifically col 5 lines 51 – 53,

> "It is an objective of the present invention to provide an apparatus for mechanically dewatering peat or sewage sludges."

And, col 5 lines 60 – 61,

> "The subject invention is directed to the dewatering of feed streams containing peat or sewage sludge."

USP 3613564 presents an apparatus for dewatering. Specifically, in the abstract,

> "An apparatus for removing aqueous liquid from a flowable material, containing aqueous liquid as a continuous phase and suspended solids as a discontinuous

> phase, to obtain a dewatered product has to endless, driven belts of elongated porous sheets."

USP 3613564 does not discuss, teach or suggest the use of aluminum sulfate, ferric chloride, DADMAC, Epi-DMA or polyacrylamide. USP 3613564 does not discuss, teach or suggest any conditioning or any dewatering of thermophiles or of thermophilic biological sludge.

USP 3397139 presents a secondary waste treatment process. Specifically, in the abstract,

> "The present invention involves an improved secondary waste treatment process."

Again, col 1 lines 65 – 70,

> "In terms of basic unit operations, the instant invention involves a secondary waste treatment process which normally comprises subjecting a waste stream to the steps of primary settling, biological oxidation and secondary settling of the effluent from the biological oxidation operation."

USP 3397139 does present an anionic polymer for use in primary settling and a cationic polymer for use in dewatering. USP 3397139 does present the blending of primary solids with secondary biological solids. However, USP 3397139 does not discuss, teach or suggest the use of aluminum sulfate, ferric chloride or a polyquaternary ammonium compound in use with a polyacrylamide. USP 3397139 does not discuss, teach or suggest any dewatering of thermophiles or of thermophilic biological sludge.

In view of the above stated facts, reconstructed claim 12 should be allowable over the combination of Nielsen, Sorensen and Pohoreski interpreted in light of Haldeman and either Schwab or Wilker and further in view of USP 4380496, USP 3613564, and USP 3397139.

112, 2nd paragraph – "a ferric chloride"

Claim 21, 25, 31, 37, 38 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought. It is unclear what "a" ferric chloride is. There appears to be but one "ferric chloride." If

applicant has disclosed more than one specie of "ferric chloride," he is requested to point to column and line of the issued patent where such disclosure can be found.

Applicant's Response

Applicant appreciates and understands the Examiner's rejection. Applicant would like to point out to the Examiner that at the time of the filing, 1996, the doctrine of equivalence was a method of patent protection. As is well known in intellectual property today, the doctrine of equivalence is difficult to utilize in claim defense, even with the Festo decision.

While the Examiner's rejection is grammatically correct, the intent of the Applicant with the "a" is to include other ferric or iron salts. Applicant would like to point out to the Examiner col 12 lines 41 – 50 of the Specification,

> Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention. It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall in between."

The reconstructed claims have been corrected to remove the Examiner's rejection; however, the Applicant does not wish or intend to limit coverage to a specific iron salt, namely ferric chloride, as there are many ways of preparing a salt having a cationic iron moiety. By incorporating the Examiner's remarks reconstructed claims 1 – 21, the Examiner's rejection is respectfully traversed.

112, 2nd paragraph – "ratios"

Claims 28 and 29 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought. The claim recites "ratios" of polyacrylamide to aluminum sulfate. At any given moment, there appears to be but one ration of polyacrylamide to aluminum sulfate. Accordingly, applicant's reference to "ratios" is unreasonably confusing. The same rationale applies to claim 29.

Applicant's Response

Applicant appreciates and understands the Examiner's rejection. The reconstructed claims have been corrected so as to overcome the Examiner's objection. In so doing, the Examiner's rejection is respectfully traversed.

112, 2nd paragraph – "thermophilic"

Claims 1 – 18, 21 – 38 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought.

Each of claims 1, 16, 17, and 18 recites "thermophilic digestion process." If by "thermophilic digestion process," applicant means a digestion process populated by "thermophiles" bacteria, then the claim is not reasonably precise in scope because USP 5650070 to Pollock (at col 3 lines 7 – 12) teaches that "there is no clear operating boundary between mesophiles and thermophiles, since some of each species exist that both mesophilic and thermophilic temperatures." If, on the other hand, applicant intends "thermophilic digestion process" to denote a digestion process operated within a particular temperature range regardless of the mesophilic/thermophilic makeup of the dominant bacterial population, then the term thermophilic is no less unclear for there does not appear to be any art-recognized agreement as to the numeric bounds of the thermophilic temperature ranges.

In particular, it is unclear whether digestion processes operated at between 105 °F and 115 °F would meet the "thermophilic digestion process" limitation of claims 1 – 18, 21 – 38. Applicant clearly indicates he regards 105 °F (40 °C) as a mesophillic temperature (col 2 line 15) and equally clear that he regards 131 °F (55 °C) as a thermophilic temperature (col 2 line 33). Applicant refers to the active bacteria at 115 °F as being of the "thermophilic variety," but is unclear whether a digestion process operated at 115 °F would meet applicant's understanding of a "thermophilic digestion process" because he states that a "thermophilic system **relies on"** (emphasis added) temperatures of 131 °F (55 °C) or higher. In short it is not reasonably clear on this record if digestion processes operated at temperatures between 40 °C and 55 °C would meet the recited limitation of a "thermophilic digestion process."

Applicant's Response

Applicant appreciates the Examiner's rejection. Applicant would like to present to the Examiner col 2 lines 28 – 33 of the Specification,

> At temperatures **of at least** 115 °F, active **bacteria are of the thermophilic variety**. Aerobic and/or anaerobic thermophilic microorganisms are used to carry out any required degradation in a thermophilic exothermic process. The **thermophilic digestion system relies on high operating temperatures** (greater than about 55 °C or 131 °F) to achieve a substantial pathogen destruction." (Emphasis added)

Applicant would respectfully like to present to the Examiner that the Specification clearly states that thermophiles begin at an operating temperature of <u>at least 115 °F</u>. Further, the Specification states that "the thermophilic digestion system relies on **high** operating temperatures" (Emphasis added)

Further, Applicant wishes to present to the Examiner that it is well known in the art that thermophiles are the predominant bacteria at operating temperatures of at least 115 °F. For example, Gould defines mesophilic digestion operating at an elevated temperature range of 30 to 40 °C (86 to 104 °F), col 2 lines 55 – 65. Further, Gould defines a temperature region wherein mesophiles decline and thermophilic forms increase. Specifically, col 4 lines 34 – 40,

> "As temperature rises from 35 C (95 °F), the population of mesophilic microorganisms decline and thermophilic forms increase. The temperature range of 45 °C to 75 °C (113 to 167 °F) is often referred to as the thermophilic range wherein thermophiles predominate and where most mesophiles are extinct."

To more accurately define the dewatered thermophilic bacteria, the Applicant has reworded reconstructed claim 1 to read "A method for dewatering thermophilic biological sludge. . ." Incorporating the above discussion and reconstructing claims 1 – 21, the Examiner's rejection is respectfully traversed.

<u>112, 2nd paragraph – "at least one of ...or"</u>

Claims 16, 21, 25, 26, 30, 31, 37, 38, 23, 26, 27, 30, 32-34 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought.

Claim 16 recites in pertinent part "adding…at least one of aluminum sulfate or [sic] ferric chloride to the biological sludge." Proper grammar requires:

a) "adding…at least one of aluminum sulfate ~~or~~ <u>and</u> ferric chloride to the biological sludge;"

b) "adding…~~at least one of~~ aluminum sulfate, ~~or~~ ferric chloride<u>, or both</u> <u>aluminum sulfate and ferric chloride</u> to the biological sludge; or

c) an expression equivalent in meaning to (a) or (b).

Claim 16 also refers to "the combination of…aluminum sulfate, ferric chloride, and polyacrylamide" thereby rendering the scope of the claim unreasonably imprecise such that the public would not be afforded fair notice of the sought-for patent protection.

Claim 26 implicitly requires that aluminum sulfate be added while Claim 27 implicitly requires that ferric chloride be added.

<u>Applicant's Response</u>

Applicant appreciates and understands the Examiner's rejection. Reconstructed claims 1 – 21 have been corrected so as to overcome the Examiner's objection. Specifically, claim 1 now reads:

1. (Amended) A method for dewatering thermophilic biological sludge, comprising:
   a. adding a primary component to the thermophilic biological sludge; said primary component comprising at least one of aluminum sulfate and ferric chloride; wherein
      said primary component may also comprise a polyquaternary ammonium compound; and
   b. adding a cationic or anionic polyacrylamide to the thermophilic biological sludge.

By so doing, the Examiner's rejection is respectfully traversed.

<u>112, 2nd paragraph – "the anionic polyacrylamide"</u>

Claims 16, 32 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is

sought. Claim 16 fails to provide antecedent basis for claim 32's recitation of "the anionic polyacrylamide." Similarly, it is unclear whether claim 32's recitation of an "anionic polyacrylamide" implicitly limits the scope of claim 16's "polyacrylamide" to an ***anionic*** polyacrylamide.

Applicant's Response

Applicant understands the Examiner's rejection. The reconstructed independent claims have been corrected to state the polyacrylamide be "cationic or anionic." The reconstructed dependent claims refer to "said cationic polyacrylamide" or to "said anionic polyacrylamide." By so doing, the Examiner's rejection is respectfully traversed.

112, 2nd paragraph – "enhance the dewatering"

Claims 1 – 18, 21 –38 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought.

Claims 1, 16, 17, and 18 refer to enhancing the dewatering of the sludge. It is unclear whether the dewatering enhancement provided by the addition of polyacrylamide and any one of the various "primary component" materials, i.e., the combination of polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride, and blends thereof (claim 1), polymeric quaternary ammonium compound and at least one of aluminum sulfate and ferric chloride (claim 16), aluminum sulfate (claim 17), or ferric chloride (claim 18), is measured relative to that degree of dewatering accomplished using just the primary component without polyacrylamide, just the polyacrylamide without the primary component, or relative to the dewatering accomplished without the use of any sludge conditioner, i.e., without any primary component or polyacrylamide.

Applicant's Response

Applicant appreciates and understands the Examiner's rejection. To correct, Applicant has removed the rejected phrase. Claim wording is now identical to the wording in the Specification. By so doing, the Examiner's rejection is respectfully traversed.

112, 2nd paragraph – "DADMAC family"

Claims 2, 23, 3, 24 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought. In claim 2, it is unclear what a "(DADMAC) family" is because DADMAC is a unique compound. It is not a genus to which more than one specie belongs. Furthermore, it is unclear what could be meant by "the...compounds [sic] are from [the] ... (epi-DMA family" because that so-called "family" includes but one lonesome member, i.e., epi-DMA. So it is unclear how a plural number of compounds (plural) could be selected from a genus having but one specie member.

Applicant's Response

Applicant appreciates and understands the Examiner's rejection. Applicant would like to point out to the Examiner that at the time of the filing, 1996, the doctrine of equivalence was a method of patent protection. As is well known in intellectual property today, the doctrine of equivalence is difficult to utilize in claim defense, even with the Festo decision.

While the Examiner's rejection is grammatically correct, the intent of the Applicant with the "family" is to include other polyquaternary ammonium compounds based upon the same moiety. Applicant would like to point out to the Examiner col 12 lines 41 – 50 of the Specification,

> Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention. It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall in between."

There are many well known methods in the industry to manufacture a polyquaternary ammonium compound from an allyl monomer. Allyl can be reacted with di-methyl amine, di-ethyl amine, methyl ethyl amine, methyl butyl amine, etc. to form a polyquaternary ammonium compound. Further, there are may well known methods to manufacture a polyquaternary ammonium compound from an epichlorohydrin (epi)

monomer. Epi can be reacted with di-methyl amine, di-ethyl amine, methyl ethyl amine, methyl butyl amine, etc. to form a polyquaternary ammonium compound.

It is with the intent to cover known equivalents that the word "family" was used. In an effort to correct and still have the claim cover alternate methods of quaternary polymer manufacture, wherein the referenced DADMAC allyl compound is used or the referenced Epi-DMA epi compound is used, Applicant has changed said claims to read "variety" instead of "family." The word "variety" has support in the Specification in the abstract and in col 5 lines 8 – 10.

Claims 2, 3 and 24 have been corrected to include "variety" instead of "family." In keeping with the intent of the claim construction and following the Examiner's grammatical guidance, the Examiner's rejection is respectfully traversed.

<u>112, 2nd paragraph – "and blends thereof"</u>

Claims 1 –18, 21 –38 are rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought. Claim 14 recites a composition comprising (a) polymeric quaternary ammonium compounds, (b) aluminum sulfate, (c) ferric chloride, and (d) "blends thereof." It is unclear whether the "blends" is a blend of (a) and (b), (a) and (c), (b) and (c), or a blend of (a), (b), and (c). Separately, it is not at all clear whether a composition comprising polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride, and polyacrylamide meeting the other limitation of the claim not at issue here, would meet all the limitations of the claim for want of presence of "blends thereof." In short, it is unclear how a mixture comprising elements X, Y, and Z does not – without having said anything more – inherently include a "blend" of X, Y, and Z. The specific recital of "and blends thereof" obfuscates what otherwise appears to be a reasonably clearly defining listing of compositional members. The same rationale applies to claims 1 – 13 and 15 – 18, 21 – 38 in which the phrase "and blends thereof" is also recited.

<u>Applicant's Response</u>

Applicant understands the Examiner's rejection. The phrase "and blends thereof" has been removed from the reconstructed claims; the Examiner's rejection is respectfully traversed.

112, 2nd paragraph – Claim 37

Claim 37 is rejected under 35 USC §112, second paragraph for failing to particularly point out and distinctly claim the subject matter for which patent protection is sought. Claim 37 cannot be understood. Claim 37 reads:

37. A composition for dewatering biological sludge according to claim 21 comprising a polymeric quaternary ammonium compound, aluminum sulfate, ferric chloride and blends thereof, as primary component, and a polyacrylamide, said components being present in the composition in dewatering biological sludge from a thermophilic digestion process.

It would appear, judging from a comparison of claim 37 as presented with issued claim 14, that the expression "a ratio to enable the composition to function as an agent for" was inadvertently omitted from the point at which applicant ceased underlining the text of new claim 37, i.e., between "in" and "dewatering." Insofar as the foregoing attribution is merely speculative on the part of the examiner, claim 37 has not been examined vis-à-vis the prior art.

Applicant's Response

Applicant understands the Examiner's rejection. Claim 37 has been deleted.

Obviousness Type Double Patenting

Claims 1 –4, 9, 10, 14, 15, 16 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 – 4, 7, 8, 13, 14, 15, respectively, of U.S. Patent No. 5846435 to Haase in view of Sorensen and Pohoreski.

Claim 1 of USP 5846435 to Haase is shown below at left. Claim 1 of the pending reissue application is shown below at right, with underlinings showing limitations (or test) not found in the parent '435 claim. Text of the '435 patent claim not appearing in the pending claim is indicated by strikethrough.

Claim 1 of USP 5846435 to Haase	Pending Claim 1
1. A method for dewatering biological sludge that has been digested by a thermophilic digestion process comprising: a. adding polymeric quaternary ammonium compounds, as primary component, to the biological sludge; and b. adding polyacrylamide to the biological sludge; such that any combinations of the polymeric quaternary ammonium compounds and of the polyacrylamides enhance dewatering of the sludge.	1. A method for dewatering biological sludge that has been digested by a thermophilic digestion process comprising: a. adding <u>a</u> polymeric quaternary ammonium compounds [sic], <u>aluminum sulfate, ferric chloride and blends thereof,</u> as primary component, to the biological sludge; and b. adding polyacrylamide to the biological sludge; such that any combinations of the <u>primary component</u> ~~polymeric quaternary ammonium compounds~~ and of the polyacrylamides enhance dewatering of the sludge.

A comparison of the left and right sides of the table above reveals the difference between the scope of the pending claim and the scope of the issued claim. Apart from the addition of polymeric quaternary ammonium "compounds" (note plurality) that is limiting of both the patented and pending claims, the pending claim is further, limited by the step of adding aluminum sulfate, ferric chloride, and blends of aluminum sulfate and ferric chloride. In the patented claim, the "primary component" limitation is met by polymeric quaternary ammonium compounds, whereas in the pending claim, the primary component must include polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride, and blends of aluminum sulfate and ferric chloride.

In view of Sorensen and Pohoreski's suggestion to use a combination of inorganic coagulants, e.g., ferric chloride and aluminum sulfate, and low molecular weight coagulants, e.g., poly DADMAC, as a primary component before addition of a higher molecular weight polymeric flocculant, it would have been obvious to have substituted a combination of polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride, and blends of aluminum sulfate and ferric chloride for the polymeric quaternary ammonium compounds recited in Haase's '435 patent claim 1.

Applicant's Response

Applicant refers to discussion of Sorensen and Pohoreski previous. Applicant has reconstructed said claim to remove any double patenting with USP 5846435. This reconstruction should place claims 1 – 21 in a position of allowance.

Subject Matter Allowable over the Prior Art

Claims 10, 11, 12, and 31 would be allowable if amended to include the limitations of the claims from which they depend, and amended to overcome any non-obvious prior art based objections and rejections set forth above. With respect to claims 10 and 31, the prior art does not appear to describe or suggest forming a "cationic overcharge" through the addition of polymeric quaternary ammonium compounds (sic, "compounds" (plural), see claim 1), aluminum sulfate, ferric chloride, "and blends thereof," the foregoing materials added directly to the sludge, with subsequent addition of an anionic polyacrylamide.

Applicant's Response

Applicant appreciates the Examiner's remarks and has incorporated the Examiner's remarks into a new claim construction.

Assignee

PTO assignment records do not show a recorded assignment of the patent at issue. If there is not assignee, applicant is requested affirmatively state so on the record.

Applicant's Response

At this time there is no assignment of the patent at issue.

New Matter – "Primary Sludge"

Claim 13 is rejected under 35 USC §112, first paragraph, as claiming subject matter not supported by the original disclosure. Unlike claims 34 – 36, claim 13 refers to the biological sludge "compris[ing[" primary sludge. The application as filed supports "mixing" the biological sludge with the primary sludge, but there is no indication that the primary sludge is itself a biological sludge, or that an element or component of the biological sludge is "primary sludge." See col 5 line 2, col 8 lines 28 – 30, col 9 line 6.

Applicant's Response

Applicant appreciates and has noted the Examiner's rejection. Claim 13 has been corrected to incorporate the word "mixing" instead of the word "comprising."

New Matter – "simultaneously with step (a)"

Claims 17, 22, 24, 28, 35 are rejected under 35 USC §112, first paragraph, as claiming subject matter not supported by the original disclosure. Claim 17 encompasses adding the polyacrylamide of step (b) at the same time that the aluminum sulfate of step (a) is added to the biological sludge. There is no support for this subject matter in the original disclosure. The claimed invention is directed to what the specification refers to as "method five." At col 8, applicant states in pertinent part: .

> Method five involves the addition of polymeric quaternary ammonium compounds, aluminum sulfate, ferric chloride and blends thereof, as primary component to the biological sludge. Polyacrylamide is **then** added to the biological sludge such that the primary component and the polyacrylamides combine to enhance dewatering of the sludge.
>
> In a preferred embodiment [of the method five invention], the polymeric quaternary ammonium compound, aluminum sulfate, ferric chloride and blends thereof **are added directly to the sludge** and, **upon formation of microflocs** of the sludge from the polymeric quaternary ammonium compound, aluminum sulfate, ferric chloride and blends thereof, a cationic **polyacrylamide is added** to form a floc that dewaters the sludge.
>
> Method five also involves ... formation of a cationic overcharge within a developed microfloc system, and an anionic polyacrylamide is **then added** for final floc formation.

(emphasis supplied). In method five, the subject matter to which claim 17 is directed, it is clear that the addition of polyacrylamide must follow (in time) the previous addition of the aluminum sulfate and other method five "primary component" constituents. Put another way, there is no indication in the original written description that applicant was in possession of the concept of adding the step (b) **flocculating** polyacrylamide at the same time that the micro floc-forming primary components were being added.

Applicant's Response

Applicant understands and appreciates the Examiner's rejection. The reconstructed claims incorporate the Examiner's rejection and remarks.

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Anticipation

Claim 14 is rejected under 35 USC § 35 U.S.C. Sec 102(b) as anticipated by USP 4711727 to Matthews. Matthews describes a composition comprising a cationic high molecular weight polyelectrolyte, such as polyacrylamide (col 13 line 23), a cationic low-molecular weight polyelectrolyte as the component (b)(col 13 line 27), e.g., DADMAC (Matthews claim 6), and alum (i.e., aluminum sulphate, per col 5 line 20)(claim 12). Matthews describes that alum, "one of the auxiliary agents selected from known flocculants" (col 5 line 16), can be added entirely into the Matthews composition, i.e., not necessarily added in part to the aqueous system being treated by the Matthews composition (col 5 lines 19 – 21). Matthews also makes clear that any of the "known flocculants" (col 5 line 17), e.g., sodium aluminate, ferric sulphate, ferrous sulphate, aluminum chlorohydrate, polyelectrolytes, or aluminum sulphate (papermakers' alum), can be added into the composition. It is clear from Matthews col 1 line 35 that Matthews appreciated that "ferric chloride" was one such known flocculant. If there were any doubt that Matthews was indeed in possession of a composition, comprising the combination of DADMAC, alum, polyacrylamide, and ferric chloride, USP 4867789 to Eida or USP 4781839 to Kelly make clear that the skilled artisan would have understood Matthews to have been in possession of the claimed invention (comprising in part "ferric chloride") because Eida and Kelly teach that "ferric chloride" was a well-known coagulant/flocculant. The recitation in claim 14 "for use in the method of claim 1," is merely a statement of intended us of the claim composition, and does not itself limit the scope of the claimed composition.

Applicant's Response

Applicant understands the Examiner's rejection and appreciates the Examiner's remarks.

Matthews, upon review, presents an aqueous <u>mineral</u> composition. Said minerals can be calcium, magnesium or aluminum. Specifically, in the abstract,

> "An aqueous slurry of mineral particles, for example calcium carbonate and/or calcium hydroxide, has a mineral solids concentration of at least 40% m/m and contains an agent that maintains the slurry at a pumpable viscosity but that acts as a flocculant upon dilution of the slurry. Suitable agents include cationic and amphoteric polyelectrolytes having nitrogen-containing groups, for example polyamines and dimethyl diallyl ammonium chloride polymers."

Again, col 5 lines 11 – 20,

"In order to improve the efficiency of the treatment of sewage with a composition of the present invention, especially with a preferred composition that contains a mixture fo lime and calcium carbonate as the mineral component, it is possible to use one or more auxiliary agents selected from known flocculants, such as sodium aluminate, ferric sulphate, ferrous sulphate, aluminum chlorohydrate, polyelectrolytes or, preferably aluminum sulphate (papermaker's alum)."

The composition of claim 14 does not have a mineral component.

Eida, upon review, presents a method for purifying a dye solution. Specifically, in the abstract,

"A method for purifying a dye solution is provided. The method comprises the steps of dissolving an impure dye in a solvent. A flocculant is then added to the dye solution in order to flocculate the impurity so that the impurity may then be removed from the solution."

Again, col 2 lines 26 – 28,

"The main characteristic of the present invention lies in the use of a flocculant for purification of a water soluble dyes."

Again, col 4 lines 40 – 44,

"The purified aqueous dye solution thus obtained can be made into an ink as it is or after adding thereto necessary additives such as a water-soluble organic solvent and the like, or can be made into a powder by removing the water present in solution."

There is no dye in the composition of claim 14.

Kelly, upon review, presents methods of removing suspended solids wherein a required component is "a tannin-based flocculant produced by reacting a condensed tannin with an amino compound and an aldehyde." Specifically, in the abstract,

"Methods are presented for flocculating and removing solids suspended in water using an inorganic component containing iron, aluminum, or a mixture thereof in combination with a tannin-based flocculant produced by reacting a condensed tannin with an amino compound and an aldehyde."

Again, col 2 lines 47 – 50,

"Preferably, the tannin-based flocculant utilized in this invention is made in accordance with disclosure of US. Pat. No. 4,558,080 which is hereby incorporated in its entirety by reference."

While a tannin-based flocculant could operate similar to a cationic polyacrylamide, there is no discussion, teaching or suggestion to use the chemicals in Kelly to dewater thermophiles or to dewater thermophilic biological sludge. In actuality, Kelly presents a method of clarification and not a method of dewatering. Therefore, while the compositions presented in Kelly lack any thermophilic component, the teachings in Kelly are in a different application and as such conflict with the teachings of Chitikela and Dentel.

Regardless, Applicant recognizes that claim 14 is a composition claim, which is dependant upon a method claim. To correct, claim 14 is deleted and a new set of claims based upon composition, claims 16 through 21, have been added. Support for these new composition claims can be found in the Specification: col 8 lines 230 – 37 and col 11 lines 18 – 34.

Request for Allowance

Applicant has addressed all of the comments, suggestions and rejections presented by the Examiner.

A prompt allowance of all claims is respectfully requested.

Examiner Barry is kindly invited to contact the Applicant directly at 281.261.9543 to discuss any matters in this proceeding.

Respectfully submitted,

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